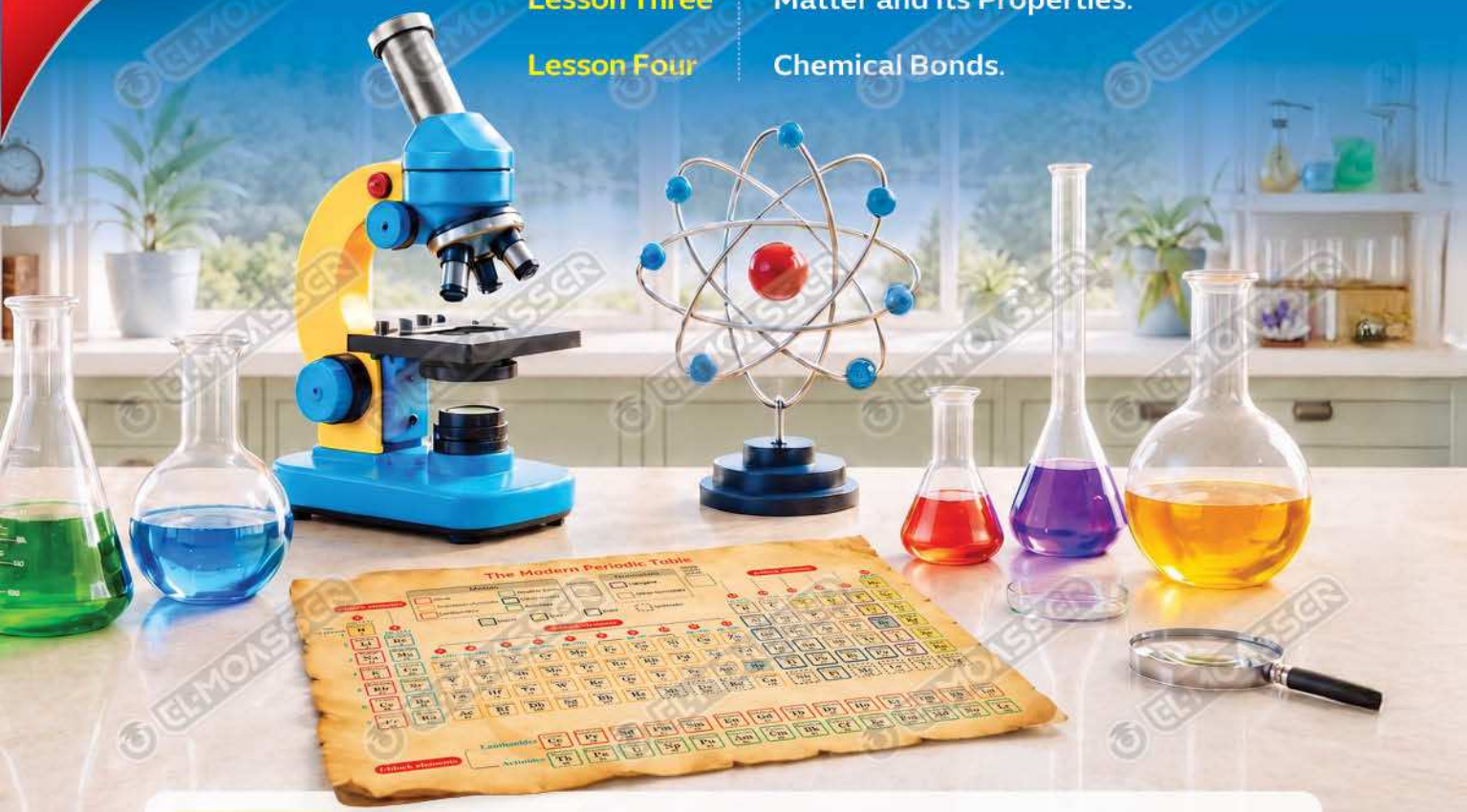
UNIT 1

The Matter

Lesson One	Structure of the Atom.
Lesson Two	The Periodic Table of Elements.
Lesson Three	Matter and Its Properties.
Lesson Four	Chemical Bonds.



Learning Outcomes By the end of this unit, the student should be able to:

1. Conclude that the atom is the building unit of any matter.
2. Appreciate the role of the scientist Ernest Rutherford in the discovering of the nucleus.
3. Understand that the atom consists of subatomic particles called protons, neutrons and electrons, which differ in charge, mass, and location within the atom.
4. Recognize that the electrons orbit in different energy levels with different shapes, and each level can carry a definite number of electrons, and any extra electron occupies the next higher energy level.
5. Determine the relationship between the number of subatomic particles that form the atom.
6. Recognize some practical applications and uses of the atom in daily life, and its benefits.
7. Outline a brief introduction to the chemist Mendeleev.
8. Realize that the periodic table reflects the atomic structure and properties of the atoms, and that some elements' atoms contain the same number of protons but different numbers of neutrons, known as isotopes.
9. Relate the number of electrons in the outer energy level of an element's atom to its position in the periodic table.
10. Gather information to relate the atomic structure and the properties of matter in the periodic table.
11. Conclude the relationship between an element's location in the periodic table and its chemical activity.
12. Analyze and explain data regarding the composition of different substances.
13. Analyze and explain data to demonstrate that pure substances consist of one type of atoms or molecules, and each substance is characterized by its physical and chemical properties, which can be used to identify it.
14. Realize that molecules are made up of different atoms bonded together in different ways, with the number of atoms in molecules ranging from two to thousands.
15. Describe that the materials differ from each other due to differences in the types of atoms that compose them and the way they are bonded together.
16. Explain a model of water molecule as an example of the bonding of the atoms in the ecosystem (combined with ecology).
17. Connect the atomic structure of carbon to its unique properties in forming simple organic materials like methane.

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Lesson ONE

Structure of the Atom

Lesson Terminology:

- Matter.
- Molecule.
- Atom.
- Proton.
- Neutron.
- Electron.
- Nucleus.
- Subatomic particles.
- Energy level.
- Atomic number.
- Mass number.
- Nucleons.
- Isotopes.

Included Skills, Values, and Issues:

- **Skills:** Prediction - Analysis - Conclusion.
- **Values:** Appreciation of scientists - Collaboration.
- **Issue:** Sustainable development.

Cross-Cutting Concepts:

Measurement and Proportion.

Lesson Objectives:

By the end of the lesson, the student should be able to :

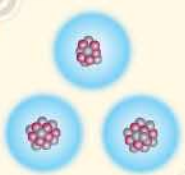
1. Conclude that the atom is the building unit of all matter.
2. Find out the role of the scientist Ernest Rutherford in discovering the atomic structure.
3. Identify the subatomic components of the atom.
4. Recognize the charges and masses of the atomic components.
5. Determine the locations of subatomic components within the atom.
6. Recognize that electrons orbit in different shapes at different energy levels.
7. Explain the chemical symbols of some elements.
8. Conclude the number of electrons that occupy energy levels.
9. Determine the relationship between the number of subatomic particles that form the atom.
10. Identify isotopes.

Lesson Preparation

These are three atomic nuclei.

This lesson explores the ideas that will help you answer these questions:

- What are the components that form the nucleus of an element's atom?
- Why is the nucleus positively charged, while the atom is neutral?
- Which two nuclei are isotopes?



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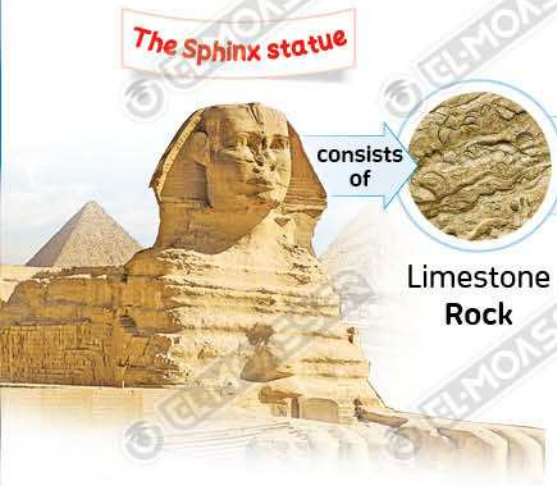
- **Everything that surrounds us anywhere on the Earth's surface is considered Matter.**

Matter
Anything that has mass and occupies space.

The atom is the building unit of matter



- **Matter** is composed of small units called **molecules**, which are composed of smaller units called **atoms**.

The Atom
The building and structural unit of any matter.

Therefore **The atom** is the building and structural unit of both the Sphinx and the Pyramids, and all matter.

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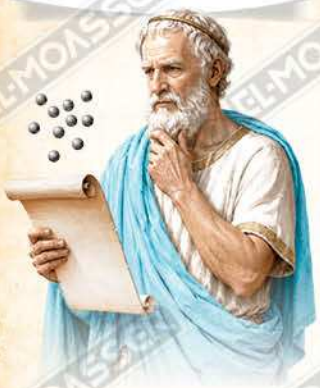
Structure of the atom

Many attempts were made to discover the structure of the atom across different eras, as shown below:

In ancient times	In the early 19th century	In the early 20th century
		
The philosopher Democritus	**The scientist Dalton**	**The scientist Rutherford**
Ancient Greek philosophers believed that matter was composed of small, indivisible parts called **atoms**.	**The scientist Dalton** formulated the first scientific theory about the atom, showing that atoms are indivisible.	**The scientist Rutherford** formulated the first atomic model on an experimental basis.

The scientist Ernest Rutherford

A New Zealand physicist, born in 1871. He won the Nobel Prize in Chemistry in 1908, and he died in 1937. In 1992, New Zealand honored him by placing his image on its one hundred-dollar note, in recognition of his efforts.

Information mentioned in the Ministry's assessments book

From the scientists who contributed to the discovery of the atomic structure are:

- **The scientist Joseph Thomson:** Who discovered the electron.
- **The scientist James Chadwick:** Who discovered the neutron.

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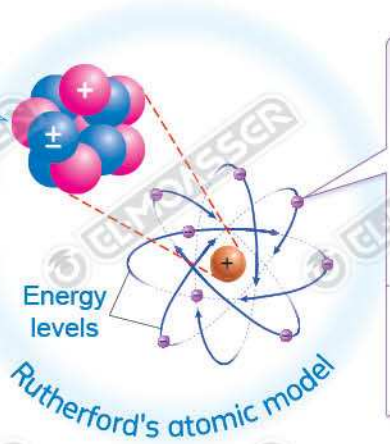
Scientists concluded that:

The atom, despite its extremely small size, it has a complicated structure, as it is composed of a central nucleus around which electrons revolve.

1. The Nucleus

Occupies a very small space in the atom, and contains two types of particles, which are:

Positively charged protons	**Neutral** neutrons



2. Electrons

Extremely small particles that revolve around the nucleus at very high speeds in certain energy levels

Negatively charged particles

Note

The nucleus is considered very small in size when compared to the size of the atom.

If we represent the size of the atom by the size of a baseball field, the size of nucleus would be represented by the size of a pinhead in the middle of the field.

Properties of the atom's components

Protons, neutrons and electrons are considered **subatomic particles.** Their masses are measured in the **atomic mass units (u)**, **and the following table shows their properties:**

Particle	Symbol	Relative electric charge	Mass
Proton	p	+1	1 u
Neutron	n	0	1 u
Electron	e^-	−1	$\frac{1}{1836}$ u

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Relative electric charge of the atom's components

Proton	Neutron	Electron
Positively charged particle (+)	Electrically **neutral** particle (±)	**Negatively** charged particle (−)

- The charge of the proton is equal to the charge of the electron in magnitude but opposite in type.

G.R.?

The nucleus of the atom is described as positively charged.
Because it contains positively charged protons and neutral neutrons.

Mass of the atom's components

Mass of proton (=) Mass of neutron

- The mass of electrons is extremely small when compared to the mass of the nucleus components. **What is the result of that ?**

The mass of electrons is neglected in calculation of the atomic mass.

G.R.?

The mass of the atom is concentrated in the nucleus.
Due to the very small mass of electrons when compared to the mass of both protons and neutrons located inside the nucleus of the atom.

Chemical symbols of elements

- Scientists agreed to represent the single atom of each element by a chemical symbol... **G.R.?**

To facilitate expressing and writing each element, especially in chemical equations.

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Rules for selecting and writing element symbols

1. The element symbol represents the single atom of it.
2. The two following tables show the names of several elements in both English and Latin languages:

Element name in English	Element name in Latin	The element symbol
Carbon	Carbo	C
Nitrogen	Nitrogenium	N
Chlorine	Chlorum	Cl
Chromium	Chromium	Cr

Element name in English	Element name in Latin	The element symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Copper	Cuprum	Cu
Iron	Ferrum	Fe

It is clear from the two tables that

Elements whose names in English match their names in Latin:

- Some are symbolized by the **first letter** of their names only, and this letter is written Capital, not small.

Nitrogen symbol: ~~n~~ ✗ N ✓

- Others are symbolized by **two letters** of their names, and written as:
  - First letter is Capital.
  - Second letter is small.

Chromium symbol: ~~CR~~ ✗ Cr ✓

Elements whose names in English differ from their names in Latin:

- Some are symbolized by the **first letter** of their **Latin** names, and this letter is written Capital, not small.

Potassium symbol: ~~k~~ ✗ K ✓

- Others are symbolized by **two letters** of their **Latin** names, and written as:
  - First letter is Capital.
  - Second letter is small.

Sodium symbol: ~~nA~~ ✗ ~~na~~ ✗ ~~NA~~ ✗ Na ✓

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G.R.?

Sodium element is symbolized by Na, not S

Because the element symbol is derived from its Latin name.

Examples for symbols of some known elements

Element	Symbol	Element	Symbol	Element	Symbol
Hydrogen	H	Potassium	K	Iodine	I
Helium	He	Magnesium	Mg	Carbon	C
Mercury	Hg	Lithium	Li	Calcium	Ca
Oxygen	O	Zinc	Zn	Chlorine	Cl
Fluorine	F	Nitrogen	N	Copper	Cu
Iron	Fe	Neon	Ne	Chromium	Cr
Phosphorus	P	Sodium	Na	Argon	Ar
Lead	Pb	Boron	B	Aluminum	Al
Sulphur	S	Beryllium	Be	Gold	Au
Silicon	Si	Bromine	Br	Silver	Ag

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Question ? Answer

Q **Water is composed of hydrogen and oxygen elements, and sulphuric acid is composed of hydrogen, sulphur and oxygen elements.**
Write the symbol of the element(s) that:
(1) is/are present in both water and sulphuric acid.
(2) is/are present in sulphuric acid but not in water.

Idea of Solution:
(1) Both water and sulphuric acid share containing hydrogen and oxygen elements.
(2) Sulphuric acid differs from water in containing sulphur element.

A (1) H , O (2) S

Life Applications

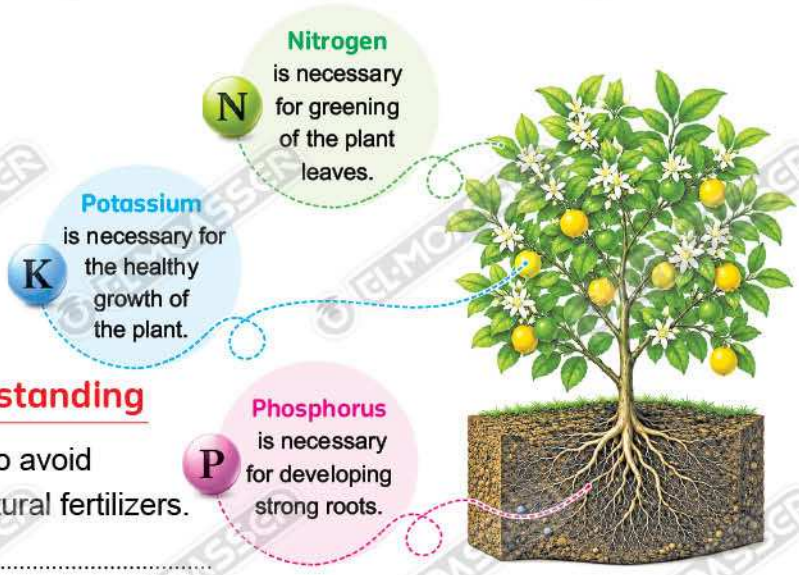
Fertilizers are used to improve agricultural crops, but their excessive use in agriculture is harmful to plants, soil, human health, animals and the environment in general.

Fertilizers
They are chemical compounds used to improve the agricultural crops.

NPK fertilizer

Among the most important types of fertilizers : NPK fertilizer

This fertilizer is composed of three compounds containing the elements:
- **Nitrogen** N
- **Phosphorus** P
- **Potassium** K



Evaluate Your Understanding

G.R.? It is recommended to avoid the excessive use of agricultural fertilizers.

*.....

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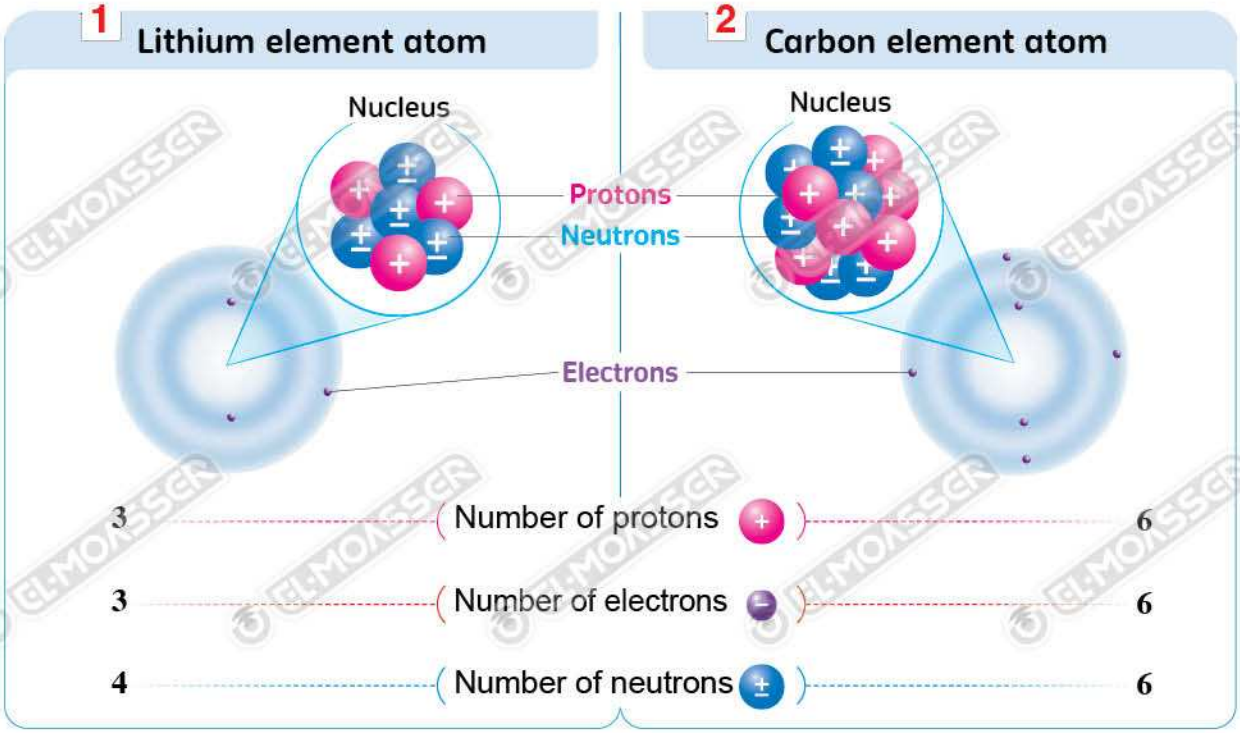
Relation between the numbers of the subatomic particles

* **The numbers of subatomic particles differ from one element to another, as shown in the following examples:**



From the atomic structure of the two elements, we can conclude the following:

1. **Number of positive protons p = Number of negative electrons e^-**

"In any element's atom"

Therefore, the atom is electrically neutral.

G.R.?

The atom is electrically neutral in its normal state.

Because the number of negative electrons revolve around the nucleus is equal to the number of positive protons inside the nucleus.

2. The **number of neutrons** may be **equal** to the **number of protons** in the nuclei of some elements' atoms, **such as: Carbon atom C**

3. The **number of neutrons** **may exceed** the **number of protons** in the nuclei of some elements' atoms, **such as: Lithium atom Li**

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* **The element symbol is expressed using two numbers, as follows:**

Mass number (A)	Written at the upper left side of the element symbol.
Atomic number (Z)	Written at the lower left side of the element symbol.

Mass number (Number of nucleons) (A)
The sum of the numbers of protons and neutrons which compose the nucleus of the element's atom.

Atomic number (Z)
The number of positive protons inside the nucleus of the element's atom.

The difference between the mass number **A** and the atomic number **Z** equals the number of neutrons inside the nucleus of the atom.

What is meant by ?

- **The mass number of chlorine equals 35**
- **The atomic number of chlorine equals 17**

It means that:

- The sum of the numbers of protons and neutrons which compose the nucleus of the chlorine atom equals 35
- The number of positive protons inside the nucleus of the chlorine atom equals 17

The mass number is mostly greater than the atomic number of the element ... G.R.?
Because the mass number equals the sum of the numbers of protons and neutrons composing the nucleus of the atom, while the atomic number equals the number of protons only.

In the electrically neutral atom:

Atomic number	=	Number of protons	=	Number of electrons	$Z = p = e^-$
Mass number (Number of nucleons)	=	Number of protons	+	Number of neutrons	$A = p + n$
Number of neutrons	=	Mass number	−	Atomic number	$n = A - Z$
Number of protons	=	Mass number	−	Number of neutrons	$p = A - n$

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The following table shows the numbers of subatomic particles in the atoms of several elements:

Numbers of subatomic particles \ Elements	Boron $^{11}_{5}B$	Beryllium $^{9}_{4}Be$	Helium $^{4}_{2}He$	Hydrogen $^{1}_{1}H$
Number of protons (p) [Atomic number]	5	4	2	1
Number of neutrons (n)	6	5	2	0
Number of electrons (e^-)	5	4	2	1
Sum of numbers (p + n) [Mass number]	11	9	4	1

Evaluate Your Understanding

Complete the following table:

Element symbol	Mass number	Atomic number ⊜	Number of protons ⊜	Number of electrons	Number of neutrons [Mass number ⊖ Atomic number]
$^{23}_{11}Na$	23	11	.....	.....	..... – ..... = ...
$^{35}_{17}Cl$	35	.....	.....	.....	18
$^{40}_{20}Ca$	.....	.....	20	.....	..... – ..... = ...

Question ? Answer

Q1 Write the symbol of sulphur element including the numbers A, Z knowing that its nucleus contains 16 protons and 16 neutrons.

Idea of Solution:

- The number (A) represents the sum of numbers of protons and neutrons (number of nucleons) = 16 + 16 = 32
- The number (Z) represents the number of protons = 16

A $^{32}_{16}S$

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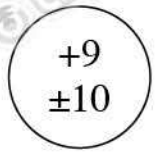
Q2 **The opposite figure represents the structure of the fluorine atom's nucleus, deduce:**



(1) The number of electrons.

(2) The atomic number.

(3) The mass number.

Idea of Solution:

- Positive particles represent protons.
- Neutral particles represent neutrons.

A **(1)** The number of electrons = Number of protons = 9

(2) The atomic number = Number of protons = 9

(3) The mass number = Number of protons + Number of neutrons = 9 + 10 = 19

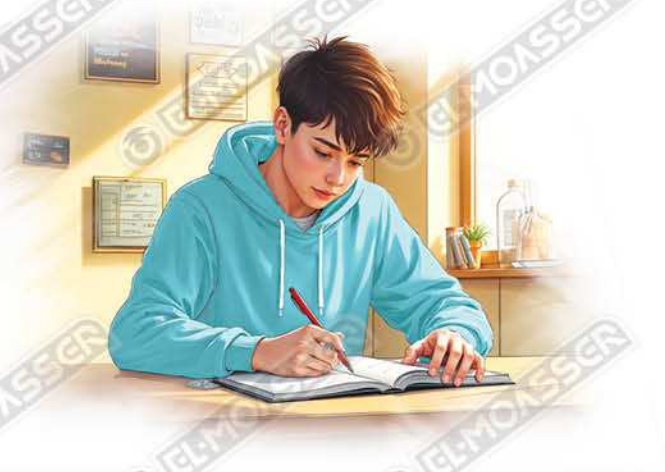
Review

The most important

- Definitions.....
- Comparisons.....
- Give reasons.....
- Figures .....
- Conclusions.....
- Uses.....

for each lesson

In the Final Revision part
included in EL-MOASSER Notebook



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Check Your Understanding 1

Answered

1 (A) Choose the correct answer:

(1) The building and structural unit of all matter is the ..... (Beheira 25)

ⓐ electron. ⓑ molecule. ⓒ atom. ⓓ cell.

(2) The chemical symbol of mercury element is ..... (Giza 26)

ⓐ Hg ⓑ Pb ⓒ Ag ⓓ Mg

(3) The scientist who formulated the first scientific theory about the atom is ..... (Giza 25)

ⓐ Rutherford. ⓑ Dalton. ⓒ Moseley. ⓓ Mendeleev.

(4) The subatomic particles which compose the nucleus of sodium atom are ..... (Dakahlia 25)

ⓐ protons and electrons. ⓑ neutrons and electrons.

ⓒ protons and neutrons. ⓓ protons, neutrons, and electrons.

(B) (1) An element X, its nucleus contains 20 neutral particles and the number of its nucleons is 39, **calculate the atomic number**. (Gharbia 25)

* .....

(2) Compare between: $^{9}_{4}Be$ **and** $^{4}_{2}He$ **"in terms of:** number of neutrons**".** (Ismailia 25)

* .....

2 (A) Complete the following statements:

(1) The chemical symbol of the ..... element is Cu, while the chemical symbol of the silver element is ..... (Giza 26)

(2) Protons are ..... charged particles and their mass equals ..... u (Beni Suef 26)

(3) The atom is ..... charged in its normal state, while the nucleus is ..... charged. (Sharkia 25)

(4) The atomic number is symbolized by ....., while the mass number is symbolized by ..... (Sohag 26)

(B) Give reason for:

(1) It is necessary for agricultural fertilizers to contain compounds that include N, P elements. (Monufia 26)

* .....

(2) The symbol of potassium is K not P (Alexandria 26)

* .....

Questions of Part 1 Look at pages 32 : 37

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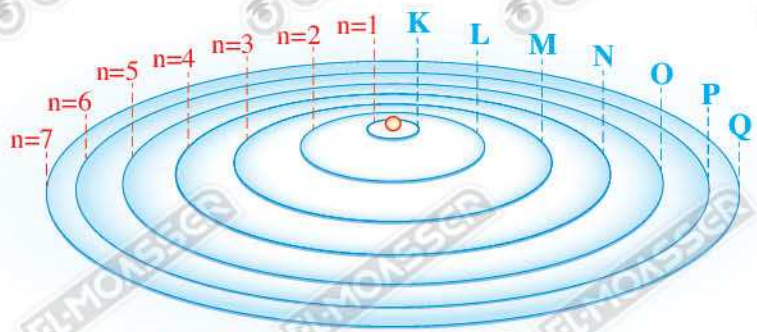
Energy levels

* Electrons revolve - each according to its energy - around the nucleus in imaginary regions known as **Energy levels.**

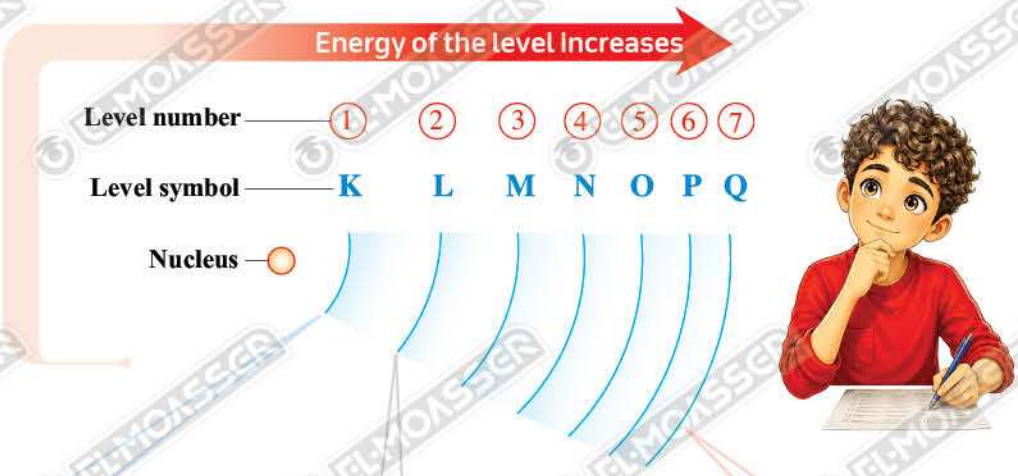
Energy levels
Imaginary regions around the nucleus in which electrons revolve, each according to its energy.

* The number of main energy levels **(n)** in the heaviest known atoms reaches 7 levels, each expressed by a certain letter, **as shown in the following figure:**



Energy levels in the heaviest known atoms

* Each level has a specific value of energy that **increases** as the electron **moves farther** from the nucleus, **therefore:**



The lowest energy level is **the first level K** (the closest to the nucleus).

The energy of level **L** is **greater than** the energy of level **K** and is **less than** the energy of level **M**, and **so on**...

The highest energy level is **the seventh level Q** (the farthest from the nucleus).

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Note

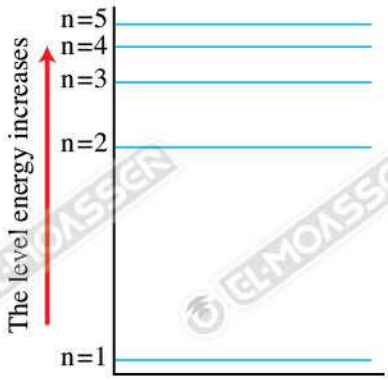
* Each main energy level consists of a number of energy sublevels, in which electrons orbit in different shapes.

It is clear that :

1. The energy of an electron increases as the energy level in which it revolves, becomes farther from the nucleus.

Since **The energy of the electron (=) The energy of the level in which it revolves**

2. The **energy difference** between each energy level and the level following it, **decreases** by **moving away** from the nucleus.
The energy difference between level L (n = 2) and level M (n = 3)
is less than
that between level K (n = 1) and level L (n = 2).



The energy of some levels in which electrons revolve around the nucleus

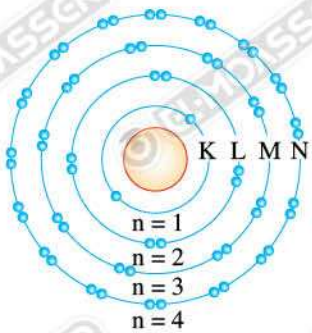
Calculating the number of electrons that saturate each main energy level

* The number of electrons that saturate each energy level of the first four levels can be determined by the corresponding mathematical relation,
as shown in the following table:

$2n^2$

(n) represents the number of the main energy level

Energy level symbol	Energy level number (n)	Number of electrons saturating the level
K	1	$2 \times (1)^2 = 2 \times 1 = 2e^-$
L	2	$2 \times (2)^2 = 2 \times 4 = 8e^-$
M	3	$2 \times (3)^2 = 2 \times 9 = 18e^-$
N	4	$2 \times (4)^2 = 2 \times 16 = 32e^-$



The number of electrons required to saturate the first four energy levels

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Rules for electron configuration in energy levels:

Each main energy level is saturated with a specific number of electrons, when this number is completed, any extra electrons occupy the next higher energy level, **as shown below:**

1. The first energy level K is filled with 2 electrons (except in the case of hydrogen H, it carries 1 electron only).
2. The higher energy levels are filled with electrons successively, according to the number of electrons in the atom of each element.

K ⟶ L ⟶ M ⟶ .....

G.R.?

Energy level L is filled with electrons before level M
Because the energy of level L is less than the energy of level M

3. The **outermost energy level** of any atom **does not contain more than** 8 electrons regardless its number, except for the level K, which does not contain more than 2 electrons.

Applications on electron configuration

Application 1 Electron configuration of the oxygen atom $^{16}_{8}O$

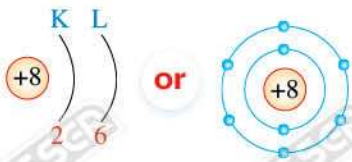
The electron configuration is done as follows:

- First energy level K ⟶ (saturated with) (2) electrons

Number of remaining electrons = $8 - 2 = 6$ **electrons**

- Second energy level L ⟶ (contains) (6) electrons

We can represent **The electron configuration of the oxygen atom $^{16}_{8}O$ as shown:**



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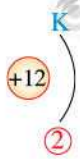
Application 2 Electron configuration of magnesium atom $^{24}_{12}Mg$

The electron configuration is done as follows:

- First energy level K saturated with (2) electrons

Number of remaining electrons = 12 – 2 = 10 **electrons**

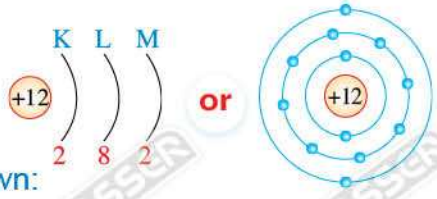


- Second energy level L saturated with (8) electrons

Number of remaining electrons = 10 – 8 = 2 **electrons**

- Third energy level M contains (2) electrons

We can represent **The electron configuration of the magnesium atom** $^{24}_{12}Mg$ **as shown:**



Application 3 Electron configuration of calcium atom $^{40}_{20}Ca$

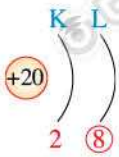
The electron configuration is done as follows:

- First energy level K saturated with (2) electrons

Number of remaining electrons = 20 – 2 = 18 **electrons**

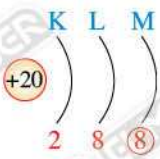
- Second energy level L saturated with (8) electrons

Number of remaining electrons = 18 – 8 = 10 **electrons**



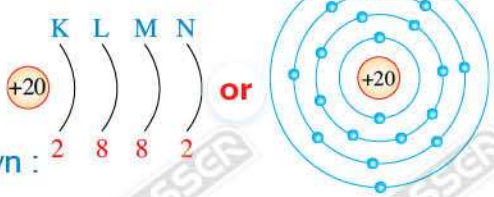
- Third energy level M saturated with (8) electrons

Number of remaining electrons = 10 – 8 = 2 **electrons**



- Fourth energy level N contains (2) electrons

We can represent **The electron configuration of the calcium atom** $^{40}_{20}Ca$ **as shown :**



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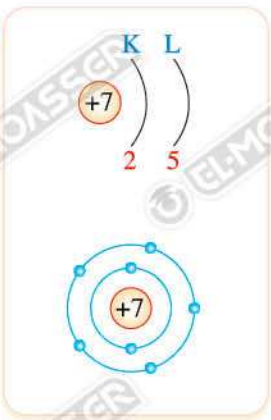
Question ? Answer

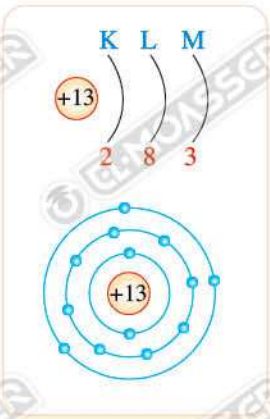
Q **Represent the electron configuration of the atom of the following elements:**

(1) Nitrogen $_{7}N$ **(2)** Aluminum $_{13}Al$ **(3)** Potassium $_{19}K$

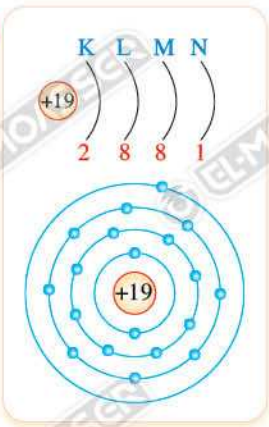
A **(1)**



(2)



(3)



Evaluate Your Understanding

Complete the following table which shows the electron configuration of atoms of some elements:

Element	Electron configuration			Number of electrons in the outermost level	Number of energy levels occupied by electrons
	K	L	M		
$^{1}_{1}H$	.....	–	–	.....	.....
$^{7}_{3}Li$	.....	.....	–	1	.....
$^{19}_{9}F$	.....	.....	–	.....	2
$^{23}_{11}Na$	.....	.....	1	.....	.....
$^{35}_{17}Cl$	.....	.....	.....	.....	3

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How to determine the atomic number of an element by knowing its electron configuration

In the electrically neutral atom:

Atomic number of the element (=) Sum of the numbers of electrons revolving in the energy levels of its atom

Question ? Answer

Q1 An element's atom whose nucleus contains 31 nucleons, its electrons revolve in 3 energy levels, and the outermost energy level contains 5 electrons. **Calculate:**

(1) The atomic number. **(2)** The number of neutrons in the atom's nucleus.

Idea of Solution:

- Number of nucleons = Mass number
- Electrons revolve in 3 energy levels, and the outermost level M contains 5 electrons.
- The first energy level K is saturated with 2 electrons, and the second energy level L is saturated with 8 electrons.

A **(1)** Atomic number of the element = Sum of the numbers of electrons revolving in the energy levels of its atom

= 2 + 8 + 5 = 15

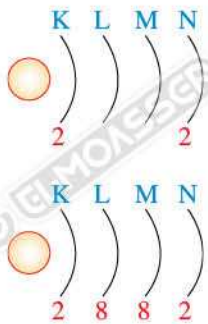
(2) Number of neutrons = Number of nucleons – Atomic number = 31 – 15 = 16 neutrons

Q2 An element's atom whose electrons revolve in 4 energy levels, where its first and last energy levels contain the same number of electrons, and its atomic number is half its mass number. **Calculate:**

(1) The atomic number. **(2)** The number of neutrons.

Idea of Solution:

- Electrons revolve in 4 energy levels, and each of the first level K and the fourth level N contains the same number of electrons.
- Each energy level L and M is saturated with 8 electrons.



A **(1)** Atomic number = Number of electrons = 2 + 8 + 8 + 2 = 20

(2) ∵ Mass number = 2 × 20 = 40

∴ Number of neutrons = Mass number – Atomic number

= 40 – 20 = 20 neutrons

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Isotopes

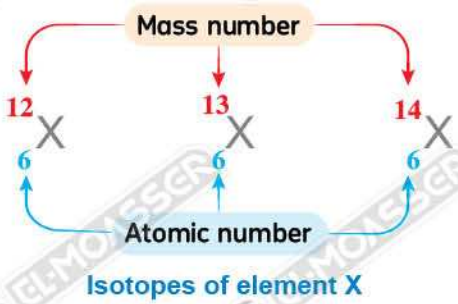
Scientists have observed that the atoms of the same element may exist naturally in different forms:

They have the same atomic number ... G.R.?

Due to the similarity in the number of protons in their nuclei, **and differ in the mass number** ... G.R.?

Due to the difference in the number of neutrons in their nuclei.

These forms are described as **isotopes**.

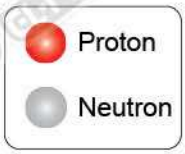


Isotopes of element X

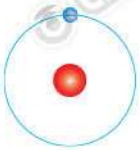
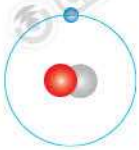
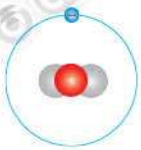
Isotopes

Different forms of atoms of the same element that have the same atomic number but differ in mass number.

Application Isotopes of hydrogen



Hydrogen element "the simplest element found in nature" has 3 isotopes, **shown in the following table:**

Isotope symbol	$^{1}_{1}H$	$^{2}_{1}H$	$^{3}_{1}H$
Isotope name	Protium	Deuterium	Tritium
Structure (Components) of the isotope atom			
Atomic number (Z)	1	1	1
Mass number (A) (Number of nucleons)	1	2	3
Number of protons (p)	1	1	1
Number of neutrons (n)	$1 - 1 = 0$	$2 - 1 = 1$	$3 - 1 = 2$

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It is clear from the previous table that:

Hydrogen isotope (Protium) $_{1}^{1}H$	Hydrogen isotope (Deuterium) $_{1}^{2}H$	Hydrogen isotope (Tritium) $_{1}^{3}H$
The only one whose nucleus does not contain neutrons, so its atomic number **equals** its mass number.	The only one in which the number of protons equals the number of neutrons, so its mass number is **double** its atomic number.	The only one in which the number of neutrons is **double** the number of protons.

Question ? Answer

Q 📖 **The following table shows the number of protons and neutrons in the nuclei of atoms of some elements:**

Element atom	(1)	(2)	(3)	(4)	(5)
Number of protons (p)	20	16	16	7	8
Number of neutrons (n)	20	20	18	8	9

Which two atoms represent two isotopes of the same element?

ⓐ (1) , (2). ⓑ (2) , (5).

ⓒ (2) , (3). ⓓ (4) , (5).

Idea of Solution :

Isotopes of the same element agree in atomic number (number of protons).

A The correct choice: ⓒ

G.R.?

Why can the number of neutrons in the nucleus of the oxygen-17 isotope not be identified from the number 17 only?

Because determining the number of neutrons requires knowing both the mass number and the atomic number, and the number 17 represents only the mass number of the element's isotope.

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Check Your Understanding 2

Answered

1 (A) Choose the correct answer:

(1) The only isotope whose nucleus doesn't contain neutrons is ..... (Minya 26)

ⓐ $^{3}_{1}H$ ⓑ $^{1}_{1}H$ ⓒ $^{4}_{2}He$ ⓓ $^{2}_{1}H$

(2) The atomic number of the element X shown in the opposite figure equals ..... (Beheira 25)

ⓐ 13 ⓑ 14 ⓒ 27 ⓓ 35

(3) Isotopes of the same element agree in ..... (Beheira 26)

ⓐ mass number. ⓑ number of nucleons.

ⓒ number of neutrons. ⓓ number of electrons.

(4) An element whose atom's outermost energy level L contains 6 electrons, its atomic number is ..... (Qena 25)

ⓐ 8 ⓑ 9 ⓒ 10 ⓓ 11

(B) (1) The electrons of an element's atom are distributed to three energy levels, and its outermost energy level contains 3 electrons. Its nucleus contains 14 neutrons. **Find its mass number**. (Sohag 25)

(2) Give reason: The energy level L is filled with electrons before energy level M (Sharkia 26)

2 (A) Put [✓] or [✗] for each statement, with correction:

(1) The first energy level K is filled with 5 electrons. (Cairo 25) ( )

(2) The atomic number of protium equals its mass number. (Qalyubia 26) ( )

(3) The energy of level N is less than the energy of level M. (Monufia 26) ( )

(4) The chlorine-37 isotope differs from the chlorine-35 isotope in containing a greater number of protons. (Gharbia 25) ( )

(B) (1) Mention the importance of the mathematical relation $2n^2$ (Dakahlia 25)

(2) Represent by a diagrammatic figure the electron configuration of the element $^{20}_{10}Ne$, **indicating** the number of protons and the number of neutrons in the nucleus of its atom. (Sohag 25)

Questions of Part 2 Look at pages 37 : 45

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Lesson Summary

Matter is everything that has mass and occupies space.

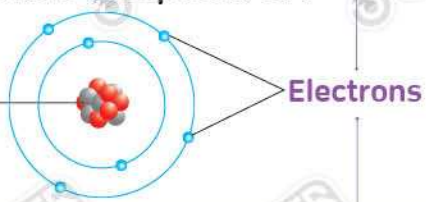
Matter → composed of → Molecules → composed of → Atoms

Evolution of the atomic concept

- **The Greek philosophers**: Believed that matter was composed of indivisible atoms.
- **Dalton**: Formulated the first scientific theory about the atom.
- **Rutherford**: Formulated the first atomic model on an experimental basis.

Structure of the atom and subatomic particles:

The atom is composed of :



- **Nucleus** — positively charged — Because it contains: **Positive proton p** & **Neutral neutrons n**
- **Electrons** — **Negatively charged particles e^-**

	Positive proton p	&	Neutral neutrons n	Negatively charged particles e^-
Charge	+1		0	−1
Mass	1 u		1 u	$\frac{1}{1836}$ u
Position	Inside the nucleus			Revolve in energy levels around the nucleus

Relation between subatomic particles :

Mass number (A): Number of protons p + Number of neutrons n

Atomic number (Z): Number of protons.

$${}^{A}_{Z}X \qquad A - Z = n$$

Number of neutrons

Examples of the symbols of some known elements:

Hydrogen	Fluorine	Sulphur	Nitrogen	Boron	Carbon	Argon	Lithium
H	F	S	N	B	C	Ar	Li
Helium	Iron	Silicon	Neon	Beryllium	Calcium	Aluminum	Iodine
He	Fe	Si	Ne	Be	Ca	Al	I
Mercury	Phosphorus	Potassium	Sodium	Bromine	Chlorine	Gold	
Hg	P	K	Na	Br	Cl	Au	
Oxygen	Lead	Magnesium	Zinc	Chromium	Copper	Silver	
O	Pb	Mg	Zn	Cr	Cu	Ag	

EL-MOASSER
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Energy levels:

- Electrons revolve around the nucleus in energy levels.
- The energy of an electron increases as the distance of its energy level from the nucleus increases.
- The first four energy levels are saturated with electrons according to the relation:

$2n^2$ — n: Main energy level number

Energy level		Level number	Number of electrons needed to saturate the energy level
First	K	$n = 1$	$2 \times (1)^2 = 2e^-$
Second	L	$n = 2$	$2 \times (2)^2 = 8e^-$
Third	M	$n = 3$	$2 \times (3)^2 = 18e^-$
Fourth	N	$n = 4$	$2 \times (4)^2 = 32e^-$

Electron configuration of elements whose atomic numbers are:

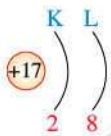
(1) from 1 to 18

Example: electron configuration of the chlorine atom $_{17}Cl$

The first energy level K is filled with 2 electrons

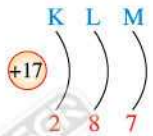
Remaining $= 17 - 2 = 15$

The second energy level L is filled with 8 electrons



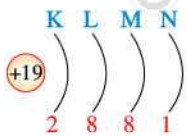
Remaining $= 15 - 8 = 7$

The third energy level M is filled with the remaining electrons

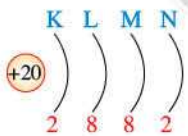


(2) 19 , 20

Potassium $_{19}K$

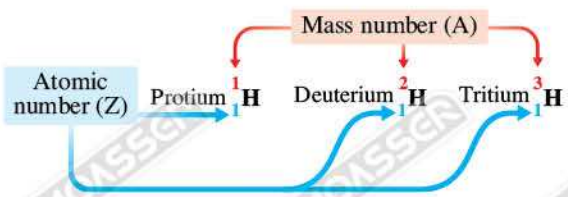


Calcium $_{20}Ca$



Isotopes:

Different forms of atoms of the same element, that have the same atomic number but differ in mass number.



Fertilizers:

- Chemical compounds used to improve agricultural crops.
- Excessive use harms the soil, plants, and human health.

NPK fertilizer contains the elements:

- **N** Nitrogen — necessary for the greening of plant leaves.
- **P** Phosphorus — necessary for developing strong roots.
- **K** Potassium — necessary for healthy plant growth.

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Questions ?

UNIT 1 | Lesson 1

First Questions Bank of EL-MOASSER Answered

Questions of Part 1 From the Beginning of the Lesson Till Relation between the Numbers of the Subatomic Particles

1 Write what indicates each of the following statements:

(1) Anything that has mass and occupies space. (Sohag 26)

(2) The building and structural unit of any matter. (Beheira 26)

(3) The first atomic model formulated on experimental basis. (Luxor 26)

(4) Chemical compounds used to improve the agricultural crops. (Monufia 26)

(5) An element necessary for the greening of the plant leaves. (Alexandria 26)

(6) Positively charged particles found inside the nucleus of the atom. (Qena 26)

(7) One of the subatomic particles whose charge can be neglected but its mass cannot be neglected. (Minya 26)

(8) Negatively charged particles in the atom with an extremely small mass, that revolve around the nucleus in energy levels. (Beheira 26)

(9) Subatomic particles whose mass can be neglected but their charge cannot be neglected. (Sharkia 26)

(10) The number of positive protons found in the nucleus of an element's atom. (Giza 26)

(11) The sum of the numbers of the protons and neutrons found inside the nucleus of an element's atom. (Cairo 26)

2 Choose the correct answer:

(1) All of the following are considered matter, **except** ..... (Giza 25)

ⓐ air. ⓑ light. ⓒ sand. ⓓ table salt.

(2) Which of the following expresses one of the properties of the atom's nucleus? (Suez 26)

ⓐ Positively charged. ⓑ Negatively charged.

ⓒ Contains negatively charged electrons. ⓓ Contains negatively charged protons.

(3) The mass of proton equals ..... (Cairo 25)

ⓐ 1 g ⓑ 1 kg ⓒ 1 u ⓓ 1 mg

(4) The subatomic particles whose mass or charge cannot be neglected are ..... (Alexandria 26)

ⓐ protons. ⓑ neutrons. ⓒ electrons. ⓓ nucleons.

(5) The subatomic particle that has the smallest mass is ..... (Luxor 26)

ⓐ electrons. ⓑ neutrons. ⓒ protons. ⓓ nucleons.

(6) The chemical symbol for the sulphur element is ..... (Monufia 26)

ⓐ Si ⓑ S ⓒ K ⓓ Ca

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(7) Which of the following represents an element and its correct symbol? (Dakahlia 25)
ⓐ Sodium S ⓑ Phosphorus F ⓒ Magnesium Mg ⓓ Potassium Po

(8) The element responsible for developing strong roots is ..... (Cairo 25)
ⓐ N ⓑ K ⓒ P ⓓ O

(9) Some fertilizers contain the ..... element which is necessary for the greening of the plant leaves. (Kafr El-Sheikh 25)
ⓐ carbon ⓑ phosphorus ⓒ nitrogen ⓓ sulphur

(10) What is the symbol of the element (X) whose nucleus contains 8 protons and 8 neutrons?
ⓐ $^{8}_{8}X$ ⓑ $^{8}_{16}X$ ⓒ $^{16}_{16}X$ ⓓ $^{16}_{8}X$

(11) The number of negatively charged particles in the aluminum atom $^{27}_{13}A$ equals .....
ⓐ 13 ⓑ 14 ⓒ 20 ⓓ 27 (Beheira 26)

(12) An element whose mass number is 23 and its atomic number is 11, then the number of its neutrons equals ..... (Beheira 26)
ⓐ 11 ⓑ 12 ⓒ 23 ⓓ 34

(13) The number of neutrons in the nucleus of the atom of the element $^{39}_{19}X$ equals ..... (Sohag 26)
ⓐ 19 ⓑ 20 ⓒ 39 ⓓ 58

3 Complete the following statements:

(1) Limestone rock is composed of molecules of ..... , which in turn are composed of smaller units called ..... (Alexandria 25)

(2) The scientist ..... formulated the first scientific theory about the atom, while the scientist ..... formulated the first atomic model on an experimental basis. (Damietta 25)

(3) Electrons revolve around the ..... at very high speeds in regions known as ..... (Beheira 26)

(4) Protons are ..... charged particles, while electrons are ..... charged particles. (Gharbia 26)

(5) Neutrons are ..... charged particles and are found inside the ..... of the atom. (Beni Suef 26)

(6) Both the proton and the neutron have the same ..... (Monufia 25)

(7) The chemical symbol for lithium element is ..... , while the chemical symbol for bromine element is ..... (Beheira 26)

(8) The chemical symbol for the ..... element is P, while the chemical symbol for the ..... element is Fe. (Qalyubia 26)

(9) The ..... element found in some fertilizers is necessary for the healthy growth of the plant. (Alexandria 26)

(10) The difference between the mass number A and the atomic number Z equals the number of ..... in the nucleus of the atom. (Alexandria 25)

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4 Correct the underlined words :

(1) The Sphinx statue is composed of **sandstone** rock. (Beheira 25)

(2) Matter is composed of **atoms**, which in turn are composed of smaller units called **molecules**. (Alexandria 25)

(3) The masses of the subatomic components are measured in **milliliter** unit. (Qalyubia 26)

(4) The chemical symbol of the potassium element is **Al** (Giza 26)

(5) An element X whose mass number is 39 and the number of neutrons in its atom's nucleus is 20, so that the number of its electrons equals **20** (Minya 26)

(6) In the nucleus of magnesium atom $^{24}_{12}Mg$, the number of protons is **double** the number of neutrons. (Monufia 26)

(7) The mass number is **half** the atomic number in the nitrogen atom $^{14}_{7}N$ (Monufia 26)

(8) The number of nucleons in the nucleus of the atom of the element $^{27}_{13}X$ equals **14** (Dakahlia 25)

5 Put (✔) or (✗) for each statement, with correction:

(1) Dalton considered that the atom is indivisible. ( )

(2) The charge of proton equals the charge of electron in magnitude and type. (Kafr El-Sheikh 26) ( )

(3) Protons are the smallest subatomic components in terms of mass. (Kafr El-Sheikh 26) ( )

(4) NPK fertilizer contains nitrogen, potassium, and calcium elements. (Beheira 26) ( )

(5) Excessive use of fertilizers in agriculture leads to improving the agricultural crops. (Gharbia 26) ( )

(6) The atomic number is written at the upper left side of the element symbol. (Cairo 25) ( )

(7) An element whose atomic number is 13 and number of its neutrons is 14, the number of its nucleons is 14 (Gharbia 26) ( )

6 Choose from column (B) what suits it in column (A):

(A)	(B)
(1) Potassium	(a) An element whose chemical symbol is Fe
(2) NPK	(b) A substance of which limestone rock is composed.
(3) Calcium carbonate	(c) An element is necessary for developing strong roots.
(4) Phosphorus	(d) A substance used to improve agricultural crops.
	(e) An element is necessary for the healthy growth of the plant.

7 Complete the following table:

Element atom	Atomic number	Mass number	Number of neutral particles	Number of positively charged particles	Number of negatively charged particles
(1) Nitrogen $^{14}_{7}N$	.....	14	.....	7	.....
(2) Chlorine $^{35}_{17}Cl$	17	.....	18	.....	.....

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8 Choose the odd word (symbol) out, then mention the relation between the rest:

(1) Electrons / Neutrons / Energy levels / Protons / Ions. (Cairo 26)

(2) u / p / n / e^-

(3) Nitrogen / Calcium / Potassium / Phosphorus.

9 Write the chemical symbol for each of the following element:

(1) Nitrogen. (Beheira 26)

(2) Sulphur. (Beheira 26)

(3) Silicon.

(4) Carbon. (Cairo 26)

(5) Hydrogen. (Cairo 26)

(6) Aluminum. (Monufia 26)

(7) Phosphorus. (Kafr El-Sheikh 26)

(8) Fluorine. (Beheira 26)

(9) Gold. (Giza 26)

(10) Copper. (Monufia 26)

(11) Zinc. (Giza 26)

(12) Chromium. (Gharbia 26)

(13) Lead. (Giza 26)

(14) Chlorine. (Beheira 26)

(15) Oxygen. (Cairo 26)

10 Give reason for each the following:

(1) The nucleus of the atom is described as positively charged. (Sharkia 26)

(2) The mass of the atom is concentrated in the nucleus. (Suez 26)

(3) The symbol of sodium is Na not So as expected. (Kafr El-Sheikh 25)

(4) NPK is from the most important types of agricultural fertilizers.

(5) It is advised not to use fertilizers excessively in agriculture. (Fayoum 26)

(6) Farmers use chemical fertilizers. (Giza 26)

(7) The atom is electrically neutral in its normal state. (Alexandria 26)

(8) The mass number is usually greater than the atomic number.

(9) The mass number is double the atomic number in the $^{16}_{8}O$ atom. (Beheira 26)

11 Compare between each of the following:

(1) The nucleus **and** the atom. (Giza 26)

(2) The electron **and** the proton, **in terms of:**

1- Relative electric charge. (Qena 26)

2- Its location in the atom. (Giza 26)

3- Mass. (Sohag 26)

(3) Phosphorus element **and** potassium element "**in terms of:** chemical symbol - its importance for the plant".

(4) The element $^{32}_{16}S$ **and** the element $^{40}_{20}Ca$ "**in terms of:** atomic number - number of neutrons". (Beheira 26)

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12 What are the results of:

(1) The number of positive protons found inside the nucleus equals the number of negative electrons revolving around it. (Monufia 26)

(2) The absence of nitrogen element for the plant. (Beheira 26)

(3) The excessive use of fertilizers. (Damietta 26)

13 Mention one importance for each of the following:

(1) The chemical symbols of elements. (Gharbia 25)

(2) Fertilizers in agriculture. (Beheira 26)

(3) Nitrogen element for the plant. (Cairo 26)

(4) Phosphorus element in fertilizers. (Sharkia 26)

(5) Potassium element for the plant. (Sohag 26)

14 What is meant by each of the following:

(1) Matter. (Giza 26)

(2) The atom. (Monufia 26)

(3) Fertilizers. (Fayoum 26)

(4) Atomic number (Z). (Luxor 26)

(5) Mass number (A). (Beheira 26)

15 What do we mean by saying that:

(1) The atomic number of sodium equals 11 (Minya 26)

(2) The number of positively charged particles in the nucleus of an element's atom = 12

(3) The number of protons in the nucleus of an element's atom = 7

(4) The mass number of calcium = 40

(5) The number of nucleons in the nucleus of an element's atom = 23

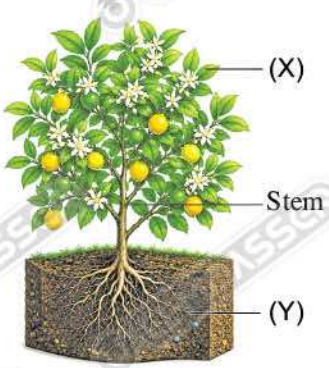
16 Study the following figures, then answer the following:

① **From the opposite figure, write the name and chemical symbol of the element necessary for:**

(1) The greening of part (X).

(2) Developing strong part (Y).

(3) Flowering and fruit growth.



② **The opposite figure represents the structure of the nucleus of potassium atom:**

(1) **Write** the chemical symbol of the element's atom, showing the atomic number and the number of nucleons on it.

(2) **Mention** the importance of this element in the field of agriculture.

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17 Variant questions:

1. **What are the elements** composing calcium carbonate substance? (Fayoum 25)

2. **Mention the most important contributions of:**
   (1) The scientist Rutherford. (Sharkia 26)
   (2) The scientist Dalton.

3. **Write the number representing each of the following:**
   (1) Mass of the proton. **(2)** Mass of the neutron.
   (3) Mass of the electron. (Beheira 25)

4. **An element whose atomic number is 11 and its mass number is 23, calculate:** (Cairo 25)
   (1) Number of electrons. **(2)** Number of neutrons.

5. **Calculate** the atomic number of an element, if the number of nucleons in its atom's nucleus is 27 and number of its neutrons is 14 (Kafr El-Sheikh 26)

6. If the atomic number of an element is 13 and its mass number is 27, **then how many protons** does it have? (Ismailia 26)

7. An element whose mass number is 40 and the number of neutrons in its nucleus is 20, **calculate** the number of electrons. (Monufia 26)

8. **When does each of the following occur:**
   (1) The mass number is equal to the atomic number. (Sharkia 26)
   (2) The mass number is double the atomic number.

Questions of Part 2 From Energy Levels Till the End of the Lesson

1 Write what indicates each of the following statements:

(1) Imaginary regions where electrons revolve around the nucleus, each according to its energy. (Fayoum 26)

(2) Different forms of atoms of the same element that have the same atomic number but differ in the mass number. (Alexandria 26)

(3) An isotope of the hydrogen element that does not contain neutrons. (Gharbia 26)

2 Choose the correct answer:

(1) The symbol (n) in the relation $(2n^2)$ refers to .....

ⓐ level number. ⓑ number of electrons.
ⓒ number of protons. ⓓ element symbol.

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(2) The second energy level L is saturated with ..... electrons. (Cairo 26)

ⓐ 2 ⓑ 8 ⓒ 18 ⓓ 32

(3) In the electron configuration, the energy level M is filled before the energy level ..... (Cairo 26)

ⓐ K ⓑ L ⓒ N ⓓ Q

(4) The energy level L in the silicon atom $_{14}Si$ contains ..... (Sharkia 26)

ⓐ 2 e^- ⓑ 3 e^- ⓒ 8 e^- ⓓ 18 e^-

(5) If the nucleus of aluminum atom contains 13 protons, the highest energy of an electron will be in the ..... level. (Gharbia 26)

ⓐ first ⓑ second ⓒ third ⓓ fourth

(6) What is the diagrammatic figure that shows the outermost energy level of the carbon atom $^{12}_{6}C$? (Qena 25)

ⓐ ⓑ ⓒ ⓓ

(7) The outermost energy level contains 7 electrons in the atom of .....

ⓐ $_{7}N$ ⓑ $_{9}F$ ⓒ $_{11}Na$ ⓓ $_{15}P$

(8) An element whose outermost energy level M is completely filled with electrons, its atomic number is ..... (Beheira 26)

ⓐ 3 ⓑ 8 ⓒ 13 ⓓ 18

(9) Isotopes of the same element agree in all of the following, **except** ..... (Beheira 26)

ⓐ atomic number. ⓑ number of protons.

ⓒ number of nucleons. ⓓ number of electrons.

(10) Deuterium is considered an isotope of the ..... element. (Qalyubia 25)

ⓐ carbon ⓑ oxygen ⓒ nitrogen ⓓ hydrogen

(11) Which of the following represents an isotope of the element $^{16}_{8}O$?

ⓐ Oxygen–8 ⓑ Oxygen–18 ⓒ Sulphur–16 ⓓ Sulphur–18

(12) Which of the following figures represents the structure of tritium atom?

ⓐ ⓑ ⓒ ⓓ

(13) The number of protons is half the number of neutrons in the nucleus of the atom of ..... (Sharkia 26)

ⓐ $^{1}_{1}H$ ⓑ $^{2}_{1}H$ ⓒ $^{3}_{1}H$ ⓓ $^{16}_{8}O$

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(14) The following figures represent the nuclei of atoms of some elements:

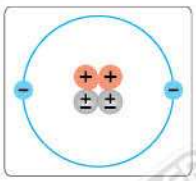
Which of the following represents the nuclei of two isotopes of the same element?

ⓐ (1) , (2) ⓑ (1) , (4) ⓒ (2) , (3) ⓓ (3) , (4)

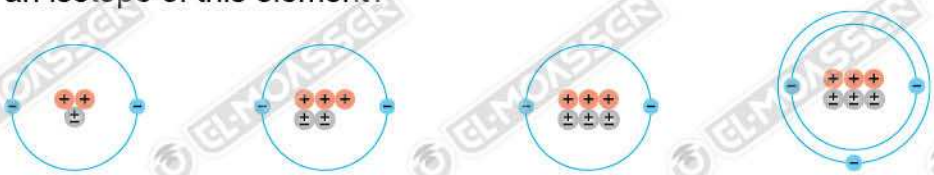
(15) The atomic number equals the mass number in a certain element when its nucleus does not contain ..... (Beheira 26)

ⓐ electrons. ⓑ protons. ⓒ neutral particles. ⓓ positive particles.

(16) The opposite figure shows the structure of one of the elements' atoms.



Which of the following figures shows the structure of an isotope of this element?



3 Complete the following statements:

(1) The number of electrons that saturate each of the first four energy levels is determined by the relation ..... (Minya 26)

(2) The second energy level is represented by the symbol ....., and is saturated with ..... electrons. (Assiut 26)

(3) In the atom of any element, the energy level M directly precedes the energy level ....., and directly follows the energy level .....

(4) The lowest energy level is the ..... level, while the highest is the ..... level. (Monufia 25)

(5) The energy of the level decreases as it gets ..... from / to the nucleus, therefore the energy of the level ..... is less than the energy of the level L (Beheira 26)

(6) The energy level K is saturated with ..... electrons, while the energy level N is saturated with ..... electrons. (Beheira 25)

(7) An element whose energy level M contains 3 electrons and its nucleus contains 14 neutrons, its atomic number is ....., and its mass number is ..... (Beni Suef 26)

(8) Isotopes of the same element agree in ..... but differ in ..... (Minya 26)

(9) The only isotope among hydrogen isotopes whose nucleus does not contain neutrons is ....., and its symbol is ..... (Beni Suef 25)

(10) Neutrons are absent in the atom when ..... equals ..... (Beheira 26)

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4 Correct the underlined words:

(1) The number of energy levels in the heaviest atoms is 9 levels. (Beni Suef 25)
(2) The outermost energy level of $_{12}Mg$ atom contains 1 electron. (Alexandria 26)
(3) The hydrogen isotope in which the number of protons equals the number of neutrons is **protium**.
(4) The chlorine–37 isotope differs from the chlorine–35 isotope in that it contains a greater number of **protons**.

5 Put (✓) or (✗) for each statement, with correction:

(1) Electrons revolve inside the nucleus in energy levels. (Fayoum 25) ( )
(2) The closest energy level to the nucleus is N and is saturated with 6 electrons. (Aswan 26) ( )
(3) The energy of the level decreases as it gets farther away from the nucleus. (Sohag 26) ( )
(4) The energy of level L is greater than the energy of level K (Suez 26) ( )
(5) The third energy level in the atom lies between the levels M and K and is saturated with 8 electrons. ( )
(6) The higher energy levels are filled with electrons firstly. (Assiut 25) ( )
(7) The number of neutrons is double the number of protons in the nucleus of tritium isotope. (Gharbia 26) ( )
(8) The magnesium–24 isotope is identical to the magnesium–25 isotope in the number of protons. ( )

6 Complete the following table:

Element atom	Chemical symbol	Atomic number	Number of nucleons	Number of neutrons	Number of protons	Electron configuration			
						K	L	M	N
(1)	$^{\cdots}_{2}He$	.....	4	.....	2	.....	-	-	-
(2) Aluminum	.....	.....	27	.....	.....	.....	.....	3	-
(3)	$^{40}_{\cdots}Ca$	.....	.....	20	.....	.....	.....	.....	2

7 Write the number representing each of the following:

(1) The number of energy levels in the largest atoms.
(2) The number of electrons that saturate the energy level M (Sharkia 26)
(3) The number of electrons in the outermost energy level of the nitrogen atom $_{7}N$
(4) The number of energy levels occupied by electrons in the atom of the element $_{11}X$ (Qalyubia 26)
(5) The number of isotopes of the hydrogen element. (Sharkia 25)

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8 Choose the odd word (symbol) out, then mention the relation between the rest:

(1) M / E / L / K (Beheira 26)

(2) $^{23}_{11}Na$ / $^{28}_{14}Si$ / $^{35}_{17}Cl$ / $^{40}_{20}Ca$

(3) $_{3}Li$ / $_{11}Na$ / $_{12}Mg$ / $_{19}K$

(4) Protium / Thorium / Deuterium / Tritium. (Dakahlia 25)

9 Give reason for each of the following:

(1) The energy level L is saturated with 8 electrons. (Alexandria 26)

(2) The energy level M is filled with electrons before level N. (Ismailia 26)

(3) The atoms of isotopes of the same element agree in atomic number and differ in mass number. (Beni Suef 26)

(4) The atomic number equals the mass number in protium. (Beheira 26)

10 Compare between each of the following:

(1) Energy level L **and** energy level M **"in terms of:** level number - number of electrons that saturate it". (Gharbia 25)

(2) Atom $^{27}_{13}X$ **and** atom $^{32}_{16}Y$ **"in terms of:** number of protons - number of electrons - number of neutrons - number of nucleons - electron configuration".

(3) Element $_{19}K$ **and** element $_{8}O$ **"in terms of:** number of energy levels occupied by electrons". (Port Said 26)

(4) Protium, deuterium, **and** tritium **in terms of:**

1- Symbol of each isotope. (Port Said 26)

2- Number of protons - mass number. (Giza 26)

11 What are the results of:

(1) The electron moving farther away from the nucleus in an element's atom (regarding its energy). (Fayoum 26)

(2) The difference in the number of neutrons in the nuclei of the atoms of the same element. (Kafr El-Sheikh 26)

(3) The absence of neutrons in the nucleus of the protium atom. (Ismailia 26)

12 Illustrate with a diagrammatic figure the electron configuration of the following atoms, with determining:

- **Number of protons.**
- **Number of neutrons.**

(1) $^{7}_{3}Li$ (Beheira 25)

(2) $^{27}_{13}Al$ (Giza 25)

(3) $^{16}_{8}O$ (Beheira 25)

(4) $^{35}_{17}Cl$ (Giza 26)

(5) $^{40}_{20}Ca$ (Cairo 26)

(6) $^{23}_{11}Na$ (Minya 26)

(7) $^{20}_{10}Ne$ (Cairo 26)

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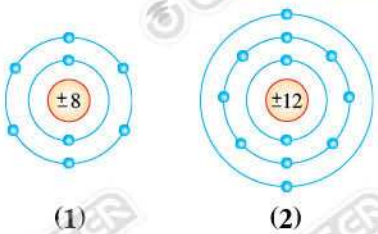
13 Study the following figures, then answer the following:

① Study the two opposite figures, then deduce: (Qalyubia 26)

(1) The atomic number for each of the two atoms.

(2) The mass number for each of the two atoms.



(1) (2)

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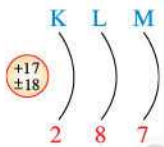
② The opposite figure represents the electron configuration of the atom of chlorine element, find: (Giza 25)

(1) The atomic number.

(2) The mass number.

(3) The number of energy levels occupied by electrons.

(4) The number of electrons in the outermost energy level.



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③ The following figures represent the electron configuration of forms of the hydrogen atom:

(1) What are the three forms called?

(2) Write the name and symbol of each figure.

(3) What is the similarity and difference between them?

(4) Write the mass number for each of them.

(1) (2) (3)

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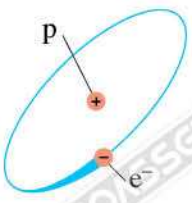
④ The following figure represents the structure of the atom of one of the hydrogen isotopes:

(1) What is the name of this isotope?

(2) What is the number of nucleons in the nucleus of this isotope's atom?



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14 Variant questions:

① The following are the symbols of some energy levels around the nucleus (K , M , L , N). Arrange these levels:

(1) Ascendingly according to the level's distance from the nucleus.

(2) Descendingly according to the level's energy.

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(2) If there are two elements (X) and (Y) whose atomic numbers are 18 and 20 respectively, **which of them** has a greater number of electrons revolving in the outermost energy level of its atom? **Clarify your answer** by representing the electron configuration of each atom.

(3) **Illustrate with a diagrammatic figure the electron configuration of the atoms of the element $^{24}_{12}Mg$ and the element $^{39}_{19}K$, then calculate for each of them:** (Sohag 26)

(1) Number of protons. (2) Number of neutrons.

(3) Number of electrons found in the outermost energy level.

(4) Number of energy levels occupied by electrons.

(4) **Mention the mathematical relation used to calculate each of the following:**

(1) The mass number of an element.

(2) The number of neutrons in the nucleus of an element's atom.

(3) The number of electrons that saturate each energy level from the first four levels. (Sharkia 26)

(5) An element whose electrons are distributed in two energy levels, its outermost energy level contains 4 electrons, and its nucleus contains 6 neutrons. **Calculate the number of nucleons for this element.** (Minya 26)

(6) **An element x whose electrons are distributed in three energy levels, its outermost energy level contains 3 electrons, and its mass number is 27:** (Sohag 26)

(1) **Illustrate** with a diagrammatic figure the electron configuration of the element.

(2) **Calculate** the number of neutrons in the nucleus of its atom.

(7) **An atom of an element whose nucleus contains 40 nucleons, and its electrons revolve in 3 energy levels where the outermost energy level contains 8 electrons, calculate:**

(1) The atomic number of the element.

(2) The number of neutrons in the nucleus of the atom.

(8) **What is meant by isotopes?** (Sohag 26)

(9) **The fluorine-18 isotope is represented by the symbol $^{18}_{9}F$, find the number of each of the following in the nucleus of this isotope:**

(1) Number of protons. (2) Number of neutrons.

(10) **From the following hypothetical symbols of elements:**

(1) $^{35}_{17}X$ (2) $^{37}_{17}X$ (3) $^{38}_{18}X$ (4) $^{81}_{35}X$ (5) $^{81}_{37}X$

What are the symbols of the two elements that represent two isotopes of the same element? **Explain your answer.**

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15 Choose the correct answer:

(1) A fertilizer package containing two compounds $(NH_4)_2SO_4$, K_2SO_4
What are the elements necessary for plant growth in this package?

ⓐ Nitrogen and hydrogen. ⓑ Sulphur and oxygen.
ⓒ Potassium and nitrogen. ⓓ Potassium and sulphur.

(2) An atom of an element whose electrons are distributed in three energy levels and the number of electrons in its outermost energy level is less than the number of electrons in the energy level L by two electrons, then the atomic number of the element equals .....

ⓐ 8 ⓑ 18 ⓒ 16 ⓓ 13

(3) An atom of an element containing 35 nucleons, if the number of neutral particles in its nucleus is 18, then the number of negatively charged particles revolving around the nucleus equals ..... (Qalyubia 25)

ⓐ 17 ⓑ 18 ⓒ 27 ⓓ 35

(4) The isotope of an element whose mass number increases by 2 will ..... (Gharbia 26)

ⓐ have 2 additional electrons. ⓑ have 2 additional neutrons.
ⓒ lose 2 electrons. ⓓ gain an electron and a proton.

(5) The ratio between the mass of the hydrogen isotope (deuterium) and the mass of the hydrogen isotope (protium) respectively equals ..... (Gharbia 26)

ⓐ 1 : 1 ⓑ 2 : 1 ⓒ 1 : 2 ⓓ 3 : 2

(6) The mass of a proton is approximately equal to the mass of the atom of ..... (Sharkia 26)

ⓐ protium ⓑ deuterium ⓒ oxygen-16 ⓓ oxygen-18

16 Complete the following statements:

(1) The ratio between the mass of the electron to the mass of the proton is ..... interger one, while the ratio between the mass of the neutron to the mass of the proton is ..... integer one. (Beheira 26)

(2) In the atom of the element $^{35}_{17}X$, the ratio between the number of electrons to the number of protons is ..... integer one, while the ratio between the number of neutrons to the number of electrons is ..... integer one. (Dakahlia 26)

17 Correct the underlined word:

The element whose outermost energy level N contains half the number of electrons in its energy level K, its atomic number is **10** (Minya 26)

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18 **An element whose atom's electrons are distributed in four energy levels, where the electrons revolving in the outermost energy level of its atom is the same number of electrons in its first energy level, and its number of protons equals its number of neutrons, find:** (Kafr-El Sheikh 26)

(1) Its atomic number. **(2)** Its mass number.

19 **Calculate the atomic number** of an element whose outermost energy level L contains double the number of electrons in the energy level K (Gharbia 26)

20 **Element Y whose atom's nucleus contains 11 protons, and number of its neutrons exceeds number of its protons by one:** (Damietta 26)

(1) Determine the number of electrons in its outermost energy level.

(2) Calculate the number of nucleons.

21 **Element X whose outermost energy level M has the same number of electrons as those found in the energy level K and its nucleus contains 12 neutrons:** (Sohag 26)

(1) Illustrate with a diagrammatic figure the electron configuration of the element.

(2) Calculate the mass number of the element.

Second School Book Questions

1 **Choose the correct answer:**

(1) What is the subatomic component that has the smallest mass? (Ismailia 26)

ⓐ Proton. ⓑ Neutron. ⓒ Electron. ⓓ Nucleon.

(2) Which of the following subatomic components has a mass equal to 1 u? (Assiut 25)

ⓐ Proton only. ⓑ Electron only.

ⓒ Each of neutron and electron. ⓓ Each of neutron and proton.

(3) The opposite figure shows the structure of the atom (x); what is the symbol that represents this atom? (Beheira 25)

ⓐ $^{13}_{7}X$ ⓑ $^{13}_{6}X$

ⓒ $^{6}_{7}X$ ⓓ $^{7}_{6}X$

(4) Which of the following atoms has a number of neutrons equals twice the number of protons in its nucleus? (Dakahlia 26)

ⓐ $^{1}_{1}H$ ⓑ $^{3}_{1}H$ ⓒ $^{4}_{2}He$ ⓓ $^{7}_{2}He$

(5) The nucleus of potassium atom contains 19 protons, then the electron with the highest energy in this atom is found in the ..... (Sharkia 26)

ⓐ first energy level. ⓑ second energy level.

ⓒ third energy level. ⓓ fourth energy level.

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(6) What is the number that is the same in all atoms of the same element? (Assiut 26)

ⓐ Mass number. ⓑ Number of electrons.

ⓒ Number of neutrons. ⓓ Number of nucleons.

(7) Which of the following choices indicates that the atom of the element is neutral?

Choices	Element	Atom components
ⓐ	Silicon	14 protons, 14 neutrons
ⓑ	Sodium	11 protons, 23 neutrons
ⓒ	Chromium	24 protons, 24 electrons
ⓓ	Iron	26 protons, 30 electrons

(8) An element whose atom's electrons are distributed in 3 energy levels, and the outermost energy level contains 3 electrons, while its nucleus contains 14 neutrons, its mass number is ..... (Dakahlia 26)

ⓐ 3 ⓑ 13 ⓒ 14 ⓓ 27

2 **Element [X] has a nucleus that contains 20 neutral particles and 39 nucleons:** (Dakahlia 26)

(1) **What** is the number of negatively charged particles in this atom?

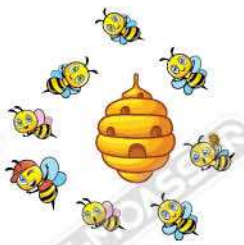
(2) **Write** the symbol of this element including the numbers of Z and A.

3 **In one of the isotopes of oxygen, the oxygen-17**

Why is it not possible to determine the number of neutrons in the nucleus of this isotope based only on the number 17?

4 **The opposite figure represents a model of the atom:**

What do the bees and the beehive represent in this model?



Answers and Ideas of Solution of School Book Questions

1 (1) The correct choice: ⓒ

(2) The correct choice: ⓓ

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(3) Idea of Solution:

∵ 6 electrons revolve around the nucleus of the atom.

∴ Number of electrons = Number of protons = Atomic number = 6

∵ The nucleus of the atom contains 7 neutrons.

∴ Mass number = Number of protons + Number of neutrons = 6 + 7 = 13

Solution: The correct choice: (b)

(4) The correct choice: (b)

(5) The correct choice: (d)

(6) Idea of Solution:

Atoms of the same element have the same atomic number, and the atomic number = number of electrons.

Solution: The correct choice : (b)

(7) Idea of Solution:

The atom is electrically neutral because the number of positive protons equals the number of negative electrons.

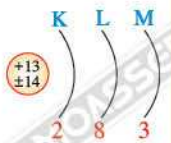
Solution: The correct choice: (c)

(8) Idea of Solution:

* Electron configuration of the element:

Mass number = Number of protons + Number of neutrons

= 13 + 14 = 27



Solution: The correct choice : (d)

2 (1) ∵ Number of protons = Mass number (number of nucleons) − Number of neutrons

= 39 − 20

= 19 protons

∴ Number of negatively charged particles (electrons) = Number of protons = 19 electrons

(2) $^{39}_{19}X$

3 Because determining the number of neutrons requires knowing the mass number and the atomic number, and the number (17) represents the mass number of the element's isotope.

4 * **Bees:** Represent the electrons revolving around the nucleus.

* **Beehive:** Represents the nucleus of the atom.

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Third ? Test on Lesson One

15 marks

1 Ⓐ Choose the correct answer: ..... / 2 marks

(1) The scientist who formulated the first atomic model on an experimental basis is ..... (Cairo 25)

ⓐ Rutherford. ⓑ Moseley. ⓒ Mendeleev. ⓓ Dalton.

(2) All of the following represent an element and its correct chemical symbol, **except** ..... (Assiut 26)

ⓐ nitrogen N ⓑ silicon S

ⓒ fluorine F ⓓ magnesium Mg

Ⓑ (1) What are the results of : ..... / 2 marks

1- The absence of neutrons in the nucleus of an element's atom. (Beni Suef 26)

* .....

2- The green plant can not obtain the nitrogen element. (Kafr El-Sheikh 26)

* .....

(2) What is meant by saying that the atomic number of the chlorine element = 17 ? (Beheira 26) ..... / 1 mark

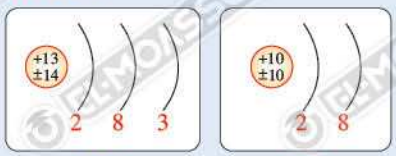
* .....

2 Ⓐ Study the two following figures, then calculate: ..... / 2 marks

(1) The mass number for each element.

* .....

* .....



(1) (2)

(2) The number of electrons revolving around each nucleus of each of the two elements' atom.

* .....

* .....

Ⓑ Write what indicates each of the following statements: ..... / 3 marks

(1) An element necessary for developing strong roots. (Qalyubia 26) (.....)

(2) One of the subatomic particles whose charge equals the charge of the electron in magnitude and opposes it in type. (Aswan 26) (.....)

(3) A scientist who formulated the first scientific theory about the atom, clarifying its indivisibility. (Dakahlia 25)

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3 Ⓐ (1) **Compare between the** element $_{16}S$ **and** element $_{7}N$ **"in terms of:** electron configuration - number of energy levels occupied by electrons". (Port Said 26)

Element $_{16}S$	Element $_{7}N$

..... / 1 mark

* .....

* .....

(2) An element whose atom's electrons revolve in 3 energy levels, and the number of electrons in its outermost energy level equals half the number of electrons in its first energy level. **Calculate the atomic number of the element.** (Kafr El-Sheikh 26)

..... / 1 mark

* .....

Ⓑ **Give reason for each of the following:**

..... / 3 marks

(1) The energy level N is saturated with 32 electrons. (Sharkia 26)

* .....

(2) Protium, deuterium and tritium are considered isotopes of the same element. (Matrouh 26)

* .....

(3) The energy level K is filled with electrons before the energy level L during the electron configuration. (Beheira 26)

* .....

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